964-105 Should Algorithms for Minute Ventilation Based Rate Adaptive Pacemakers Compensate for Metabolic Acidosis During Exercise?

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Most rate adaptive algorithms for ventilation based pacemakers (PM's) provide a linear increase in paced heart rate (PHR) for a given increase in minute ventilation (MV). It was the objective of this study to determine whether the PHR to MV slope should decrease at the PM patient's ventilatory threshold, a known correlate to metabolic acidosis.

15 Meta VVI-R 1206 PM patients (mean age 64 ± 10 yrs; 11 male, 4 female) with AV-nodal ablation (4) and bradyarrhythmic atrial fibrillation (11) and 23 age-matched healthy subjects performed treadmill exercise tests using the "Ramping Incremental Treadmill Exercise" protocol with "breath-by-breath" gas exchange. A 3rd generation algorithm using a rate augmentation factor of "low" coupled with a rate response factor was programmed to reduce the HR to MV slope midway between the lower and upper programmed rates (= 90% of the age predicted maximum rate).

The HR/MV slope from rest to ventilatory threshold (slope A) in the PM patients was 2.0 ± 0.9 beats/l, as compared to 1.4 ± 0.6 beats/l in the 23 age-matched normals ($p < 0.05$). No significant difference was observed in the HR/MV slope between ventilatory threshold and peak exercise (slope B), as compared to normals; 0.9 ± 0.5 beats/1 vs. 1.0 ± 0.3 beats/l, respectively. The ratio of slope A to slope B in the PM group was 2.8 ± 1.5 vs. 1.45 ± 0.7 in normals, indicating a decrease from slope A to B in the PM patients of 54.5%, as compared to 28% in normals.

In contrast to the linear coupling of MV changes and PHR, the 3rd generation algorithm can generate a "biphasic" HR to MV slope during exercise, more closely simulating the physiological HR to MV ratio. Rate augmentation can provide an appropriate response to the increase in MV above the ventilatory threshold. However, its initial response below the ventilatory threshold should be reduced in order to normalize the PHR to MV's ratio of slope A to slope B.

964-106 Does Faster Heart Rate Response With Rate Responsive Pacing Translate Into Better Oxygen Kinetics?

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Heart rate (HR) response and O_2 kinetics were assessed during fixed work-rate submaximum treadmill exercise (Ex) test of 10 patients with ablation induced complete AV block and a dual sensor Legend Plus pacemaker (PM). Each patient performed Ex to achieve peak VO_2 = 72 ± 12% of anaerobic threshold when the PM was randomly programmed to VVI, VVIR-activity (act), minute ventilation (mv) or combined(dual). The max VO_2 achieved with all 4 modes were not different. The max HR were not different among the 3 VVIR modes.

	VVIRact	VVIRmv	VVIRdual
Ex HR latency (sec)	15.5 ± 4.5	44.5 ± 14.2*	16.1 ± 9.5
Ex HR time constant (sec)	34.9 ± 17.2*	60.8 ± 18.5	68.8 ± 26.7
Time to ½ HR increase	39.7 ± 11.6*	86.7 ± 23.8	63.8 ± 23.3
Recovery HR latency	18.9 ± 9.3	53.0 ± 15.2*	37.4 ± 22.0
Recovery HR time constant	35.7 ± 10.3*	80.1 ± 17.2	82.9 ± 18.9
Time to ½ HR decrease	64.4 ± 10.7*	108.5 ± 12.8	94.8 ± 10.0

*Significantly different from the other 2 modes

The time constant of the VO_2 changes at the onset of exercise and at recovery were longer for VVI than for the 3 VVIR modes which were not different from each other. O_2 deficit and debt were larger for VVI than for the 3 VVIR which were not different from each other.

Conclusions: Act provided the fastest HR response during onset and recovery of Ex, and mv was slowest, while dual was intermediate. However, there was no significant difference in the O_2 kinetics among the 3 VVIR modes. This study suggests that in these relatively well patients the speed of the HR response of the sensors is not important in the exercise performance of the patients.

964-107 Increased Prevalence of Significant Tricuspid Regurgitation in Patients With Transvenous Pacemaker Leads

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The purpose of this study is to determine if transvenous pacemaker leads (TP) are associated with an increased prevalence of moderate to severe tricuspid regurgitation (TR). We reviewed 37,705 consecutive echocardiograms performed at Mount Sinai Medical Center between 1987–94. There were 745 patients who had transvenous pacemaker leads identified by echocardiography. Patients with left ventricular (LV) dysfunction, moderate to severe mitral regurgitation, significant mitral annular calcification, moderate to severe pulmonary hypertension, significant left ventricular hypertrophy, and moderate to severe aortic stenosis were excluded since these conditions may exacerbate tricuspid regurgitation.

Patients with TP (n = 355) were compared to an age–sex matched control population (CP) (n = 703). The mean age of the TP group (77 ± 12 years) was similar to the CP (76 ± 12 years) (p = 0.18). The percentage of females in each group was also similar (TP 57.3% vs. 55.6% p = 0.64).

The prevalence of moderate to severe TR in patients with TP was significantly greater than the CP (TP 18.9%; 95% CI 15.1–23.4% vs. CP 8.5%; 95% CI 6.6–10.9% Chi square $p < 0.00001$). The odds ratio for moderate to severe TR in the TP population vs. the CP was 2.5 (95% CI 1.69–3.70).

Transvenous pacemaker leads are associated with an increased prevalence of moderate to severe tricuspid regurgitation and therefore may be a risk factor for its development.

964-108 Is There a Risk for Interactions Between Mobile Phones and Single-Lead VDD Pacemakers?

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Mobile phones (MP) are increasingly regarded as a potential source of pacemaker (PM) interference. Close contact to a PM may cause tracking, inhibition or conversion to the noise mode. Patients with single-lead VDD-pacemakers might be at special risk, since the atrial sensitivity is routinely programmed to low values.

Methods: We studied 31 consecutive patients (pts), 14 f, age 61 ± 18 y, with high degree AV-block and a single-lead VDD-PM, during routine follow-up. 12 pts. with a Unity 292–07 (Intermedics), 10 with a Thera 8948/8968i (Medtronic) and 9 with a Saphir 600 (Vitatron) VDD-PM. After a complete PM check the atrial and ventricular channels were programmed to minimum sensitivity thresholds (A: 0.1–0.25 mV, V: 1.0 mV) and to unipolar ventricular sensing to simulate "worst conditions". During continuous ECG recording, the antenna of a MP (Orbitel 902, 2 W, digital D-net), was brought in direct contact with the pts' skin, parallel to the PM-lead. Then the following operations were performed: Connection to the net, making a call, ringing phase, receiving a call and leaving the net. Thereafter the PM was inquired and checked for changes of the programmed parameters.

Results: In our group of pts with VDD-PMs we observed no case of PM-interaction with the MP. All PMs showed unchanged programmed parameters after the test.

Conclusion: Although tested at minimum sensitivity thresholds with direct skin contact of the antenna, the single-lead VDD pacemakers examined were free from interference with a 2 Watt mobile phone in the digital D-net. Therefore the use of such phones should not be restricted for patients. with one of the pacemakers tested.

965 Sudden Death and Defibrillation

Tuesday, March 26, 1996, Noon–2:00 p.m.
Orange County Convention Center, Hall E
Presentation Hour: 1:00 p.m.–2:00 p.m.

965-96 Encircling Overlapping Waveforms for Transthoracic Defibrillation

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Rotating the electrical shock vector 360° around the chest during transthoracic defibrillation may facilitate defibrillation by depolarizing myocytes with different orientation vis-a-vis the shock field. To evaluate this, we recorded the percent successful defibrillation achieved by several waveforms at varying energy levels (25, 50, 100, 150 Joules (J)) in 15 dogs with electrically induced VF of short duration (30 secs). The waveforms tested included three encircling overlapping truncated exponential waveforms lasting 6, 7, 14 ms (6 EO, 7 EO, 14 EO) respectively, delivered from 6 electrode pads oriented circumferentially. These were compared to a standard damped sinusoidal waveform (lateral-lateral pathway) and a truncated exponenital biphasic waveform (5 msec positive, 1 msec negative (B5-1) (lateral-lateral pathway).

TUESDAY POSTER